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PROSPECTS AND PROBLEM AREAS FOR THE DEVELOPMENT OF TELECOMMUNICATIONS IN THE EUROPEAN SATELLITES 1959-75

CIA/RR EP 64-21

April 1964

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FOREWORD

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[redacted]

The publication is focused on the buildup of the strategic telecommunications resources of the European Satellites* during 1959-75. It is concerned solely with the development of mainline facilities and their relationship to intra-Bloc and domestic needs for conventional and specialized telecommunications. Consequently, only the basic facilities operated and controlled by the various civil departments of post and telecommunications are covered. Independent functional systems such as those serving the armed forces and the Communist Party are not considered.

* For the purposes of this publication, the term European Satellites refers to Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, and Rumania. The terms Soviet Bloc and Bloc are used interchangeably and include all of these countries as well as the USSR.

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PROSPECTS AND PROBLEM AREAS FOR THE DEVELOPMENT OF TELECOMMUNICATIONS IN THE EUROPEAN SATELLITES 1959-75

Summary

Faced with mounting pressures for more and better communications, the European Satellites in 1959 began a cooperative long-term program (1959-75) for the development of a modern integrated intra-Bloc communications system that would be responsive to official and military requirements for automated and high-speed telephone, telegraph, data, and television services. To achieve this end, the main development thrust during 1959-65 was keyed to the installation of a compatible mix of high-capacity coaxial cable and microwave radio relay transmission systems that would meet both present and projected intra-Bloc and domestic needs for an arterial communications network. At the same time, work also was to begin on the automation of intra-Bloc telephone and telegraph exchange facilities, and Bloc-wide television service was to be inaugurated.

Since its inception the program has been marked by steady progress. Although only small segments of the 2,000 miles of 4-tube coaxial cable and 4,750 miles of high-capacity microwave radio relay lines had been completed by April 1964, large sections were nearing completion. Moreover, an automated intra-Bloc telegraph network was activated by mid-1962, operations on a Bloc-wide television network began in 1963, and early in 1964 work was nearing completion on a semiautomatic intra-Bloc telephone network.

Installation of the new transmission base should be completed by the end of 1965 or soon thereafter. Because of chronic Bloc-wide shortages of associated carrier-frequency multiplex equipment, these new facilities will not operate at their designed capacities, but they will nevertheless function as part of an integrated network capable of handling a wide range of conventional and specialized services. This improved capability also will serve to strengthen the posture of strategic and tactical military communications by closing the gap that exists at present between the modern weapons systems deployed throughout the European Satellites and the communications facilities and services needed for their support and command control.

During 1966-75 the initial effort will be on completing all main intra-Bloc and domestic communications lines and equipping them to operate at their designed capacities, but main emphasis will be on the expansion and full automation of intra-Bloc and domestic telephone and telegraph exchange and subscriber facilities. Over-all development

plans for domestic systems may be impeded by expanding requirements for investment funds and equipment, although the intra-Bloc systems probably will be completed according to plan because of their strategic importance. Even if delays do occur in individual domestic systems, however, the over-all telecommunications system of the European Satellites will be vastly improved by the end of 1975.

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I. Integrated Development Through 1965

A. Organization for Cooperation Among Socialist Countries in the Fields of Post and Communications (OSS)

The establishment of OSS* in 1957 set in motion forces that are producing a striking change in the structure and composition of the telecommunications services and facilities of the European Satellites. Since its inception, OSS has had as its major long-range objective the establishment of a modern Bloc-wide telecommunications system that can meet the burgeoning requirements of official and military users, and to a lesser extent the general public, for automated, high-speed, conventional and specialized telephone, telegraph, data, and television services. Toward this objective the European Satellites undertook the following as their initial program for 1957-65: (1) the construction of an integrated arterial network of high-capacity transmission systems, (2) the partial automation of telephone and telegraph exchange facilities, and (3) the inauguration of intra-Bloc network television service.

After a somewhat halting start in 1957 and 1958 -- marked by indecision as to the choice of equipment and the routing of intra-Bloc transmission lines as well as by problems in mobilizing indigenous material, manpower, and technological resources -- development of the system began in earnest in 1959. Since that year, steady if not spectacular progress has been made. Although far from complete, the work that has begun represents the hard core of a modern Bloc-wide telecommunications system.

B. System Development

1. High-Capacity Transmission Systems

A prerequisite to the establishment of a modern Bloc-wide telecommunications complex was the construction of an extensive network of arterial transmission systems to serve both intra-Bloc and domestic communications needs. Consequently, in the selection of high-capacity transmission media, care was taken to introduce compatible systems that incorporated modern, yet proven, communications techniques. As shown on the map, Figure 1,** intra-Bloc arterial routes use 4-tube coaxial cable and broadband microwave radio relay facilities that have a capacity of up to 2,000 telephone channels plus television. Facilities used on domestic communications routes consist of 8-pair and 14-pair

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* Membership in OSS includes the following countries: the USSR, Albania, Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, Rumania, Communist China, Mongolia, North Korea, and North Vietnam. Although not a member, Yugoslavia does have observer status.
** Following p. 4, below.

double-track styroflex multiconductor cables that can handle up to 960 and 1,680 telephone channels, respectively, and microwave radio relay systems with capacities of from 24 to 120 telephone channels plus television.

The current status of 4-tube coaxial cable and high-capacity Vesna-type* microwave radio relay lines in the European Satellites is shown in the table. Although only about 3 percent of

Status of Intra-Bloc Coaxial Cable
and Microwave Facilities in the European Satellites
April 1964 and Planned for 1965

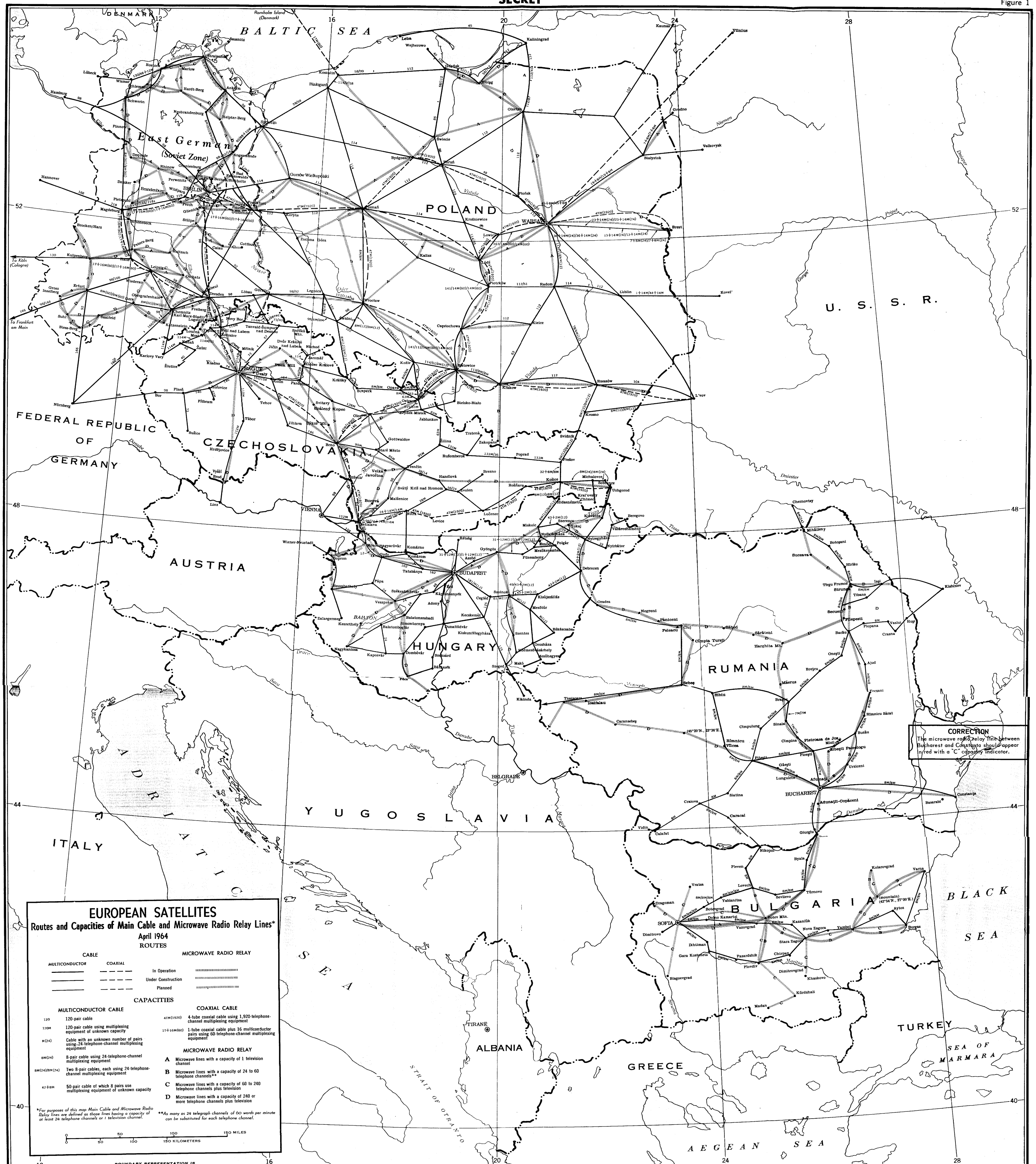
Miles

Type of Facility	In Operation	Under Construction	Planned for 1965	Total
4-tube coaxial cable lines				
Czechoslovakia	0	600	0	600
East Germany a/	0	140	40	180
Poland	60	420	740	1,220
Total	60	1,160	780	2,000
Vesna-type microwave radio relay lines				
Bulgaria	0	180	30	210
Czechoslovakia	600	50	100	750
East Germany	0	400	380	780
Hungary	0	340	520	860
Poland	30	800	180	1,010
Rumania	580	160	400	1,140
Total	1,210	1,930	1,610	4,750

a. Not including 1-tube coaxial cable lines, of which there are 110 miles in operation, 40 miles under construction, and 60 miles planned.

* "Vesna" is a 4-gigacycle (4,000-megacycle) microwave radio relay system manufactured by the USSR that has from three to six radio-frequency trunks.

Figure 1



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the planned coaxial cable lines and 25 percent of the Vesna-type microwave radio relay lines are operational, a considerable part of the facilities under construction are nearing operational status. On most coaxial cable routes under construction in Poland and Czechoslovakia, for example, the cable and repeater tanks already are installed, with partial or full operation contingent on the installation of associated multiplex equipment. As for microwave radio relay lines, Vesna-type towers are completed or are nearing completion on nearly all routes under construction in Bulgaria, Hungary, and Rumania, and the installation of transmission equipment is believed to be imminent.

Apart from the choice of transmission systems, a determined effort to construct a diversified and reliable telecommunications system is explicit in the configuration of both the domestic and the intra-Bloc networks. The arterial routes of most domestic networks consist of parallel microwave radio relay and hardened cable systems. Duplication of high-capacity transmission systems also is provided for in the network of intra-Bloc lines. The main axis of this network interconnects Moscow, Warsaw, Prague, and East Berlin with parallel installations of 4-tube coaxial cable and Vesna-type microwave radio relay lines. This balanced installation of facilities, including the hardened construction of cable terminal and repeater stations and the construction of bypass cable rings around major industrial and strategic areas, improves the reliability of communications inasmuch as traffic can flow over alternate media or routes should any part of the network become inoperable. Photographs of microwave radio relay and coaxial cable facilities are shown in Figure 1A.*

2. Automation of Telephone and Telegraph Systems

The introduction of modern high-capacity transmission systems has given added stimulus to the efforts of the European Satellites to automate their domestic telephone and telegraph systems. Gains in converting these domestic systems to semiautomatic and fully automatic operations are emphasized by the progress made in establishing new automated networks for intra-Bloc telephone and telegraph traffic.

a. Telephone

The first stage in the construction of an automated long-distance intra-Bloc telephone network is nearing completion. The network, as shown on the map, Figure 2,* should be operational by the end of 1964, at which time it will connect each of the capital cities of the European Satellites and the USSR with one another and with the

* Following p. 6, below.

capitals of Western Europe. Initially the network will operate on a semiautomatic basis, with conversion to fully automated subscriber dialing scheduled by the end of 1974.

Warsaw, Prague, and East Berlin have dual roles in the network, functioning both as main terminals and as main transit centers. In this latter capacity they control and direct the flow of all network traffic. In 1961, experimental operations were successfully conducted on test lines between Moscow, Prague, and East Berlin and between these cities and a number of cities in Western Europe. In these tests a new crossbar exchange, the Tesla MN-60, was used. This exchange -- designed jointly by Soviet, Hungarian, East German, and Czechoslovak technicians -- is now in series production at the Tesla factories in Czechoslovakia and will be used throughout the network. Currently, MN-60 equipment is installed at the new international exchange offices located in East Berlin and Prague, and installation of similar exchanges is underway in Warsaw and Moscow. When the Warsaw and Moscow exchanges are completed late in 1964, network operations will begin. In the initial period, Budapest, Sofia, and Bucharest will be connected to the network through their existing exchange facilities. These exchanges also will be supplied eventually with MN-60 equipment.

b. Telegraph

A fully automated general telegraph (GENTEX) network for intra-Bloc telegraphic communications was activated in June 1962. The coverage of the GENTEX network, which is independent of the domestic telegraph and subscriber telegraph (TELEX) systems, is shown on the map, Figure 3.

Since attaining operational status the GENTEX network has functioned smoothly. The automatic routing of telegraph traffic through intermediate points of the network has enabled the normal telegram transmission-delivery cycle to be reduced to about 30 minutes and has improved significantly the quality of service.

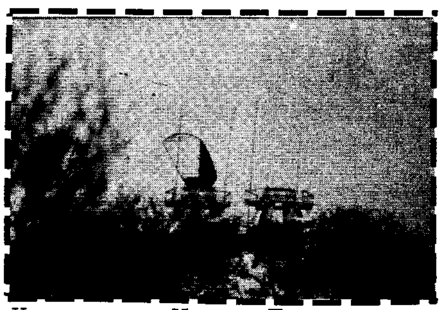
Consideration is being given to the expansion of the GENTEX network to include additional Bloc terminals and to the interconnection of the GENTEX network with similar networks now operating in Western Europe. Eventually, new Bloc terminals probably will include all main stations of individual domestic telegraph systems. Their inclusion, however, will be dependent on conversion to fully automated operations, a step that is currently underway in most of the European Satellites.

3. Intra-Bloc Television Network

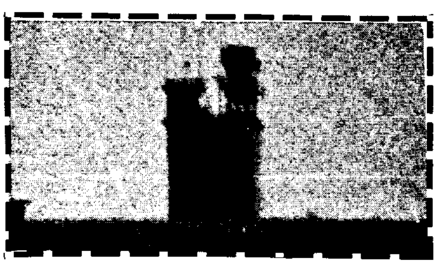
In the entire spectrum of Bloc pronouncements in the field of telecommunications, the greatest publicity has been given to the

Poland: Buried Coaxial Cable Repeater at Rzeszow

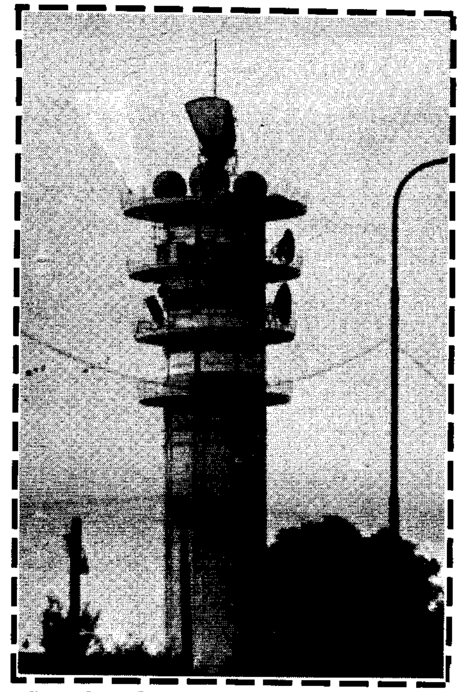
Poland: Coaxial Cable Repeater Awaiting Installation at Krakow



Hungary: Vesna-Type Microwave Radio Relay Facility at Budapest



Bulgaria: Vesna-Type Microwave Radio Relay Facility at Turnovo



Czechoslovakia: Vesna-Type Microwave Radio Relay Facility at Prague

Rumania: Vesna-Type Microwave Radio Relay Facility at Adunatii-Copaceni

Figure 1A. European Satellites: Coaxial Cable and Vesna-Type Microwave Radio Relay Facilities

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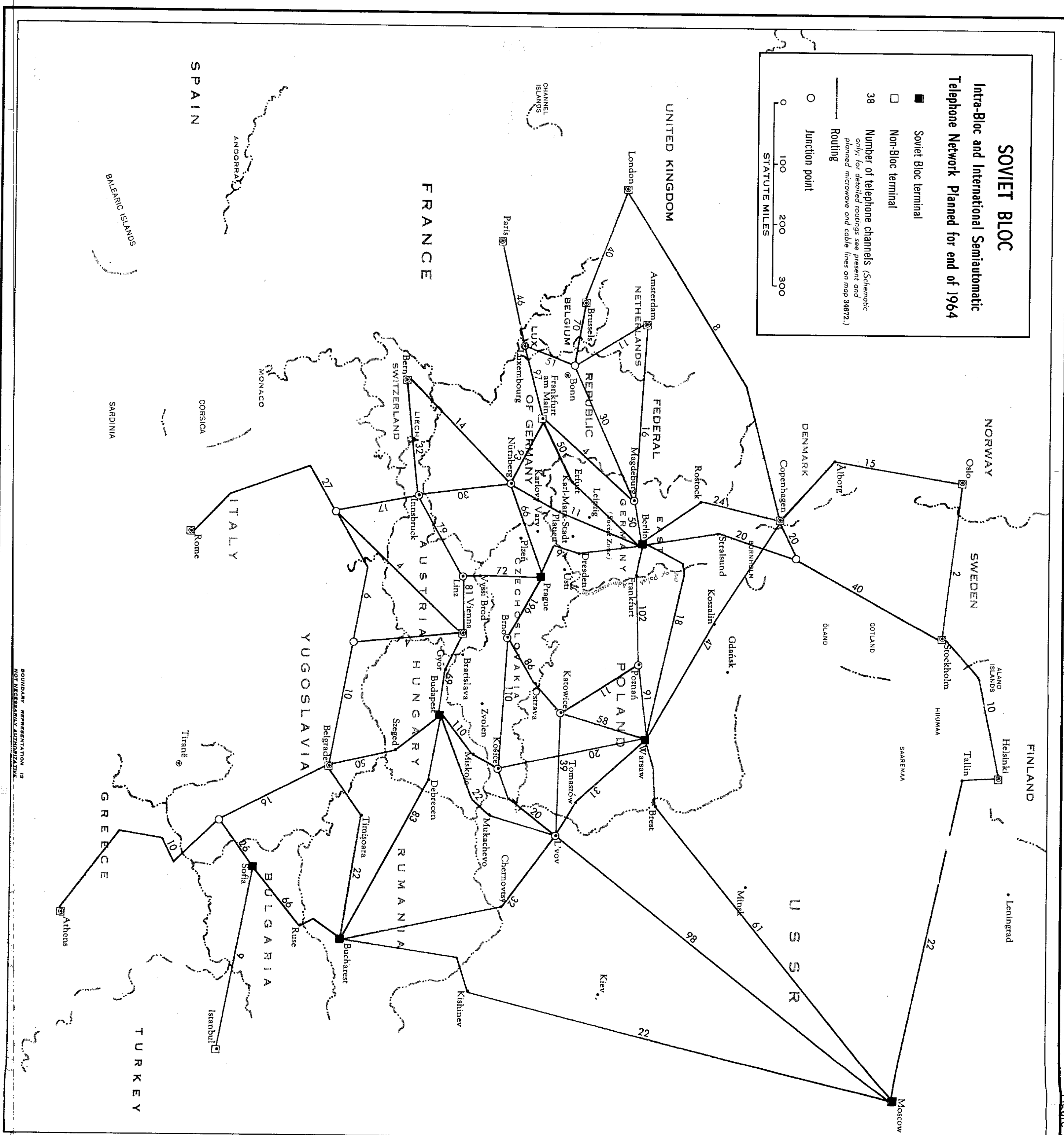

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Figure 2

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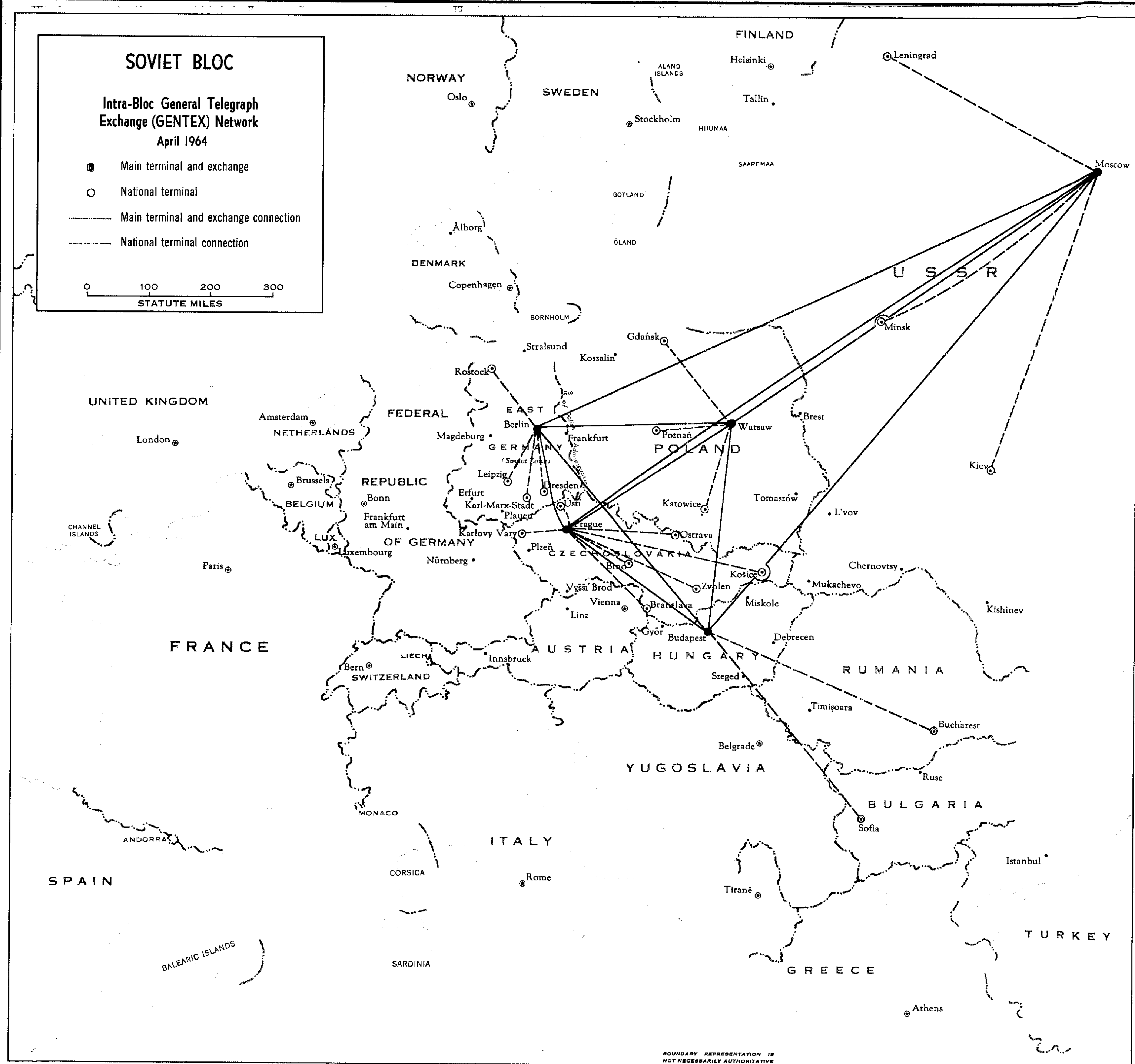
Figure 3



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establishment of the Bloc-wide television network Intervision. Sponsored by the International Radiobroadcasting and Television Organization (OIRT),* Intervision connects the television systems of the European Satellites and the USSR and provides connections with Eurovision, the Western European television network. Network operations began in 1960, at which time the television systems of East Germany, Czechoslovakia, Hungary, and Poland were linked through the use of temporary microwave radio relay facilities. Since that year, coverage of the network has grown steadily, and temporary connections subsequently have been replaced by fixed installations. In 1962 the USSR joined the network, and Bloc-wide coverage was achieved early in 1963 when the television systems of Bulgaria and Rumania were linked to the network.

The main network of arterial intra-Bloc and domestic communications lines serves as the transmission base for the Intervision network. These facilities (shown on the map, Figure 1**) depict main Intervision lines and border connecting points and provide some insight into the coverage of the television systems of individual Satellite countries. Because of the multipurpose nature of these new arterial lines, it is not unreasonable to assume that the publicity given to the establishment of the Intervision network, at least in its formative years, served as a convenient facade to shield the development of a strategic telecommunications resource base. In any case, the Bloc-wide functioning of the network demonstrates that still another major goal of OSS is nearing completion.

C. Major Problem Areas

As might be expected, problem areas exist that may prevent the European Satellites from meeting all plans by 1965. Foremost among these, and indeed the most pressing immediate problem, is the shortage of carrier-frequency multiplex equipment. Such shortages have existed since the inception of the program, and there is no evidence to suggest that significant progress has been made during the past 5 years toward the elimination of these shortages. The immediacy of the problem stems from the buildup of intra-Bloc and national arterial routes that has carried with it a massive requirement for associated multiplex equipment with capacities ranging from 12, 24, and 60 telephone channels up through and including equipment capable of handling 1,920 telephone channels. An adequate supply of such equipment is absolutely necessary for the full or even partial functioning of newly constructed lines as well as those scheduled for completion by the end of 1965.

* OIRT is an agency organized and dominated by the Soviet Bloc that effects cooperation among Bloc countries as well as some non-Bloc countries in the field of radiobroadcasting and television.
** Following p. 4, above.

Although 12-channel and 24-channel equipment appears to be manufactured in sufficient quantities to meet new and recurring needs, series production of equipment with a capacity of 60 or more channels lags seriously. At present, East Germany, Hungary, and Czechoslovakia are the only European Satellites producing 60-channel equipment, and their output falls far short of minimal needs. Furthermore, production of higher capacity equipment is nonexistent even though research for the development of such equipment has been underway for a number of years. Because of these failings, lines completed during the last 3 or 4 years are not being equipped to operate at levels approaching designed capacities. The magnitude of this problem is indicated by the fact that no completed Vesna-type microwave radio relay line in the European Satellites is known to be passing telephone traffic. Similarly the passage of telephone traffic over the nearly completed 4-tube coaxial cable route connecting Poland, Czechoslovakia, and East Germany is wholly contingent on the ability of the USSR to supply associated carrier equipment. In spite of the fact that a commitment has been made in this regard, it is still not certain that it will be met as scheduled.

The lag in the availability of carrier equipment is related to continued difficulties in mastering techniques for the series production of uniformly high-quality components, such as crystal filters and metal contacts. Even when 60-channel equipment has been delivered and installed, its performance has often failed to meet minimum standards. An outstanding example of this is the V-60 and V-60S equipment produced by East Germany.

D. Emergence of a Bloc-Wide Strategic Telecommunications Complex

The end of 1965 will see the emergence of a Bloc-wide telecommunications complex that can promote more effectively the economic, military, and political interests of the area. Although the arterial routes of intra-Bloc and domestic communications lines in the European Satellites will not be completed fully by the end of 1965, they will nevertheless begin to function as an integrated network that is capable of handling a broad array of conventional and specialized service. This vastly improved level of communications will be achieved in spite of the difficulties that are being experienced in equipping the new transmission systems.

This improved capability will have a significant impact on the posture of military communications. The new complex of arterial transmission systems will contribute greatly toward closing the gap existing between the modern offensive and defensive weapons systems deployed throughout the European Satellites and the communications facilities and services needed for their support. The increased reliability of these facilities as well as their extensive geographic coverage (which includes all major areas of strategic military importance) assures their use as the primary media for domestic and intra-Bloc military traffic. Usage will encompass a wide field of strategic and tactical military applications ranging from supporting long-distance command-control structures to meeting national and Bloc air defense requirements. Gains made in automating domestic and intra-Bloc telephone and telegraph networks also will serve to enhance the strategic military significance of the emerging Bloc telecommunications system.

II. Plans and Prospects, 1966-75

In the early part of 1966-75 a push will be made to complete all main intra-Bloc and domestic communications lines and to equip these lines to their designed capacities. Some technological advances will be made by the introduction of new transmission media, but the main emphasis throughout the period will be on the expansion and automation of exchange and subscriber facilities, both domestic and intra-Bloc.

A. Technological Developments

1. Cable and Microwave Radio Relay Facilities

With the exception of the introduction of some 1.5 megacycle small-diameter coaxial cable and some more advanced microwave radio relay systems operating in the 6-gigacycle range,* there will be little over-all change in the basic composition of transmission systems. The use of small-diameter coaxial cable will be confined primarily to Poland and Czechoslovakia as feeder lines off main coaxial cable and microwave radio relay routes. For the most part, 6-gigacycle microwave radio relay equipment will be used to upgrade existing arterial microwave radio relay routes to meet additional traffic needs. This new microwave equipment, which is currently under development at the Budapest Telecommunications Research Institute, supposedly is capable of handling television traffic as well as 10,000 telephone channels. Reportedly it will use carrier equipment with a capacity of 1,920 telephone channels per radiofrequency trunk.

2. Scatter Facilities

There are no known operational tropospheric scatter facilities in the European Satellites. Moreover, there appears to be no operational requirement for this medium for mainline communications purposes even though East Germany is conducting feasibility studies over five experimental circuits. These circuits connect the main terminal at Kolberg (near East Berlin) with Dresden, Fichtelberg, and Inselberg (all in East Germany) and with Poznan (in Poland) and Prague (in Czechoslovakia).

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* One gigacycle equals 1,000 megacycles.

The applicability of tropospheric scatter to the communications requirements of the USSR is more apparent. Field tests of experimental tropospheric scatter systems in the USSR date back to 1957. At that time a circuit was set up between Leningrad and Petrozavodsk, a distance of 192 miles, using frequencies of 310 megacycles and 1,000 megacycles. The existence of a second experimental circuit between Frunze and Przheval'sk, a distance of about 180 miles, was announced in April 1958. More recently, official statements have alluded to plans for the construction of tropospheric scatter facilities by 1965. Evidence of operational systems, however, has been limited largely to isolated reports of probable tropospheric scatter antennas south of Moscow. In spite of this scarcity of information, it is believed that the USSR has a program for the employment of tropospheric scatter systems in the remote reaches of the Arctic and in Central and Eastern Siberia to support the growing economic and military requirements of these areas for high-capacity and reliable communications facilities.

3. Communications Satellites

Within the Soviet Bloc, only the USSR has the economic and technical resources to undertake an independent program for the establishment of a communications satellite system. There is, however, little incentive for the USSR to undertake such a program, as the major economic justification for a communications satellite is its use on high-density transoceanic routes. Although Soviet transoceanic communications requirements are growing through increased economic and political contact with non-Bloc countries, they are nevertheless minimal. Moreover, most of the high-density traffic requirements of the USSR are with contiguous European Satellite countries. Internal Soviet and intra-Bloc facilities that are planned for completion by the end of 1965 will have sufficient capacity and potential for expansion to satisfy these requirements at least through 1975.

The major alternative to establishing an independent communications satellite system is cooperating with the West in worldwide or regional systems. A joint venture with Western nations would be particularly attractive because it would enable the USSR to apply the scientific, engineering, and manufacturing resources necessary for an independent system to other priority programs and to relate service costs more realistically to service requirements.

Although Soviet intentions are unclear, there has been some recent evidence to suggest interest in cooperation with the West. If such cooperation materializes, access to Western communications satellite systems probably would be made available to European Satellite countries through Soviet ground terminals.

4. Electronic Switching Facilities

The European Satellites have tied long-run improvements in the quality and quantity of telephone service to the eventual widespread introduction of electronic telephone exchange (EATZ) equipment. The use of such equipment, which has no moving contacts, would increase switching speeds as much as 1,000 times and would reduce greatly the installation, operating, and maintenance costs. Since 1961, East Germany, under the aegis of OSS, has been coordinating a Bloc-wide effort to develop EATZ equipment for operational introduction by 1970 or soon thereafter. Efforts to date, however, have not resulted in significant progress because of problems in the mass production of low-cost, reliable semiconductor components with an operating lifespan of 20 to 30 years. Once this bottleneck is overcome, series production of equipment should move ahead. Significant quantities of such equipment, however, probably will not be available for operational use until 1975.

B. Completion of a Modern Telecommunications Resource Base

In their attempt to complete a modern telecommunications resource base by the end of 1975, the European Satellites will be faced with an expanding requirement for investment funds and equipment. The completion of new transmission systems soon after 1965 will not terminate the need for large capital outlays.* Rather, it will signify the end of one stage in the plan for the development of telecommunications and the beginning of another more intensified stage -- that of expanding telephone, telegraph, and data exchange and subscriber facilities so as to exploit the expanded channel capacities of new domestic and intra-Bloc networks. In countries such as Poland and Czechoslovakia, for example, plans for 1960-80 provide for the rapid expansion of all telecommunications services, including a major program for installing 5 million more telephones in each country. Given a minimum estimated investment cost of $200 for each additional telephone subscriber line, capital outlays in each country for telephone facilities alone would approximate $1 billion for the 20-year period. This level of investment, even when considered on an annual basis of $50 million, coupled with investments involved in enlarging other telecommunications services, will constitute a heavy demand on the financial and economic resources of these countries for telecommunications.

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Even assuming that the investment requirements for programs of this magnitude can be met, it is nevertheless evident that progress made throughout 1966-75 will be contingent on the increased availability of modern telecommunications equipment, especially high-capacity carrier systems and exchange and subscriber facilities. Although cognizant of this requirement, the European Satellites may not be able to cope fully with it, because of competing military demands on existing facilities for manufacturing electronics equipment and deficiencies in production technology.

These factors suggest that not all major objectives for modernizing and expanding the telecommunications system of the European Satellites will be met by the end of 1975. The strategic importance of intra-Bloc systems insures their completion, but it is unlikely that complementary goals for enlarging domestic systems will be met entirely. Even if the attainment of domestic goals is delayed as much as 5 years, however, the telecommunications systems of the European Satellites, in view of the extensiveness of the over-all program, will be improved vastly by 1975.

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PROSPECTS AND PROBLEM AREAS
FOR THE DEVELOPMENT OF TELECOMMUNICATIONS
IN THE EUROPEAN SATELLITES
1959-75

April 1964

Sanitized version

FOREWORD

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The publication is focused on the buildup of the strategic telecommunications resources of the European Satellites* during 1959-75. It is concerned solely with the development of mainline facilities and their relationship to intra-Bloc and domestic needs for conventional and specialized telecommunications. Consequently, only the basic facilities operated and controlled by the various civil departments of post and telecommunications are covered. Independent functional systems such as those serving the armed forces and the Communist Party are not considered.

* For the purposes of this publication, the term European Satellites refers to Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, and Rumania. The terms Soviet Bloc and Bloc are used interchangeably and include all of these countries as well as the USSR.

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PROSPECTS AND PROBLEM AREAS FOR THE DEVELOPMENT OF TELECOMMUNICATIONS IN THE EUROPEAN SATELLITES 1959-75

Summary

Faced with mounting pressures for more and better communications, the European Satellites in 1959 began a cooperative long-term program (1959-75) for the development of a modern integrated intra-Bloc communications system that would be responsive to official and military requirements for automated and high-speed telephone, telegraph, data, and television services. To achieve this end, the main development thrust during 1959-65 was keyed to the installation of a compatible mix of high-capacity coaxial cable and microwave radio relay transmission systems that would meet both present and projected intra-Bloc and domestic needs for an arterial communications network. At the same time, work also was to begin on the automation of intra-Bloc telephone and telegraph exchange facilities, and Bloc-wide television service was to be inaugurated.

Since its inception the program has been marked by steady progress. Although only small segments of the 2,000 miles of 4-tube coaxial cable and 4,750 miles of high-capacity microwave radio relay lines had been completed by April 1964, large sections were nearing completion. Moreover, an automated intra-Bloc telegraph network was activated by mid-1962, operations on a Bloc-wide television network began in 1963, and early in 1964 work was nearing completion on a semiautomatic intra-Bloc telephone network.

Installation of the new transmission base should be completed by the end of 1965 or soon thereafter. Because of chronic Bloc-wide shortages of associated carrier-frequency multiplex equipment, these new facilities will not operate at their designed capacities, but they will nevertheless function as part of an integrated network capable of handling a wide range of conventional and specialized services. This improved capability also will serve to strengthen the posture of strategic and tactical military communications by closing the gap that exists at present between the modern weapons systems deployed throughout the European Satellites and the communications facilities and services needed for their support and command control.

During 1966-75 the initial effort will be on completing all main intra-Bloc and domestic communications lines and equipping them to operate at their designed capacities, but main emphasis will be on the expansion and full automation of intra-Bloc and domestic telephone and telegraph exchange and subscriber facilities. Over-all development

plans for domestic systems may be impeded by expanding requirements for investment funds and equipment, although the intra-Bloc systems probably will be completed according to plan because of their strategic importance. Even if delays do occur in individual domestic systems, however, the over-all telecommunications system of the European Satellites will be vastly improved by the end of 1975.

I. Integrated Development Through 1965

A. Organization for Cooperation Among Socialist Countries in the Fields of Post and Communications (OSS)

The establishment of OSS* in 1957 set in motion forces that are producing a striking change in the structure and composition of the telecommunications services and facilities of the European Satellites. Since its inception, OSS has had as its major long-range objective the establishment of a modern Bloc-wide telecommunications system that can meet the burgeoning requirements of official and military users, and to a lesser extent the general public, for automated, high-speed, conventional and specialized telephone, telegraph, data, and television services. Toward this objective the European Satellites undertook the following as their initial program for 1957-65: (1) the construction of an integrated arterial network of high-capacity transmission systems, (2) the partial automation of telephone and telegraph exchange facilities, and (3) the inauguration of intra-Bloc network television service.

After a somewhat halting start in 1957 and 1958 -- marked by indecision as to the choice of equipment and the routing of intra-Bloc transmission lines as well as by problems in mobilizing indigenous material, manpower, and technological resources -- development of the system began in earnest in 1959. Since that year, steady if not spectacular progress has been made. Although far from complete, the work that has begun represents the hard core of a modern Bloc-wide telecommunications system.

B. System Development

1. High-Capacity Transmission Systems

A prerequisite to the establishment of a modern Bloc-wide telecommunications complex was the construction of an extensive network of arterial transmission systems to serve both intra-Bloc and domestic communications needs. Consequently, in the selection of high-capacity transmission media, care was taken to introduce compatible systems that incorporated modern, yet proven, communications techniques. As shown on the map, Figure 1,** intra-Bloc arterial routes use 4-tube coaxial cable and broadband microwave radio relay facilities that have a capacity of up to 2,000 telephone channels plus television. Facilities used on domestic communications routes consist of 8-pair and 14-pair

* Membership in OSS includes the following countries: the USSR, Albania, Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, Rumania, Communist China, Mongolia, North Korea, and North Vietnam. Although not a member, Yugoslavia does have observer status.
** Following p. 4, below.

double-track styroflex multiconductor cables that can handle up to 960 and 1,680 telephone channels, respectively, and microwave radio relay systems with capacities of from 24 to 120 telephone channels plus television.

The current status of 4-tube coaxial cable and high-capacity Vesna-type* microwave radio relay lines in the European Satellites is shown in the table. Although only about 3 percent of

Status of Intra-Bloc Coaxial Cable
and Microwave Facilities in the European Satellites
April 1964 and Planned for 1965

Miles

Type of Facility	In Operation	Under Construction	Planned for 1965	Total
4-tube coaxial cable lines				
Czechoslovakia	0	600	0	600
East Germany a/	0	140	40	180
Poland	60	420	740	1,220
Total	60	1,160	780	2,000
Vesna-type microwave radio relay lines				
Bulgaria	0	180	30	210
Czechoslovakia	600	50	100	750
East Germany	0	400	380	780
Hungary	0	340	520	860
Poland	30	800	180	1,010
Rumania	580	160	400	1,140
Total	1,210	1,930	1,610	4,750

a. Not including 1-tube coaxial cable lines, of which there are 110 miles in operation, 40 miles under construction, and 60 miles planned.

* "Vesna" is a 4-gigacycle (4,000-megacycle) microwave radio relay system manufactured by the USSR that has from three to six radio-frequency trunks.

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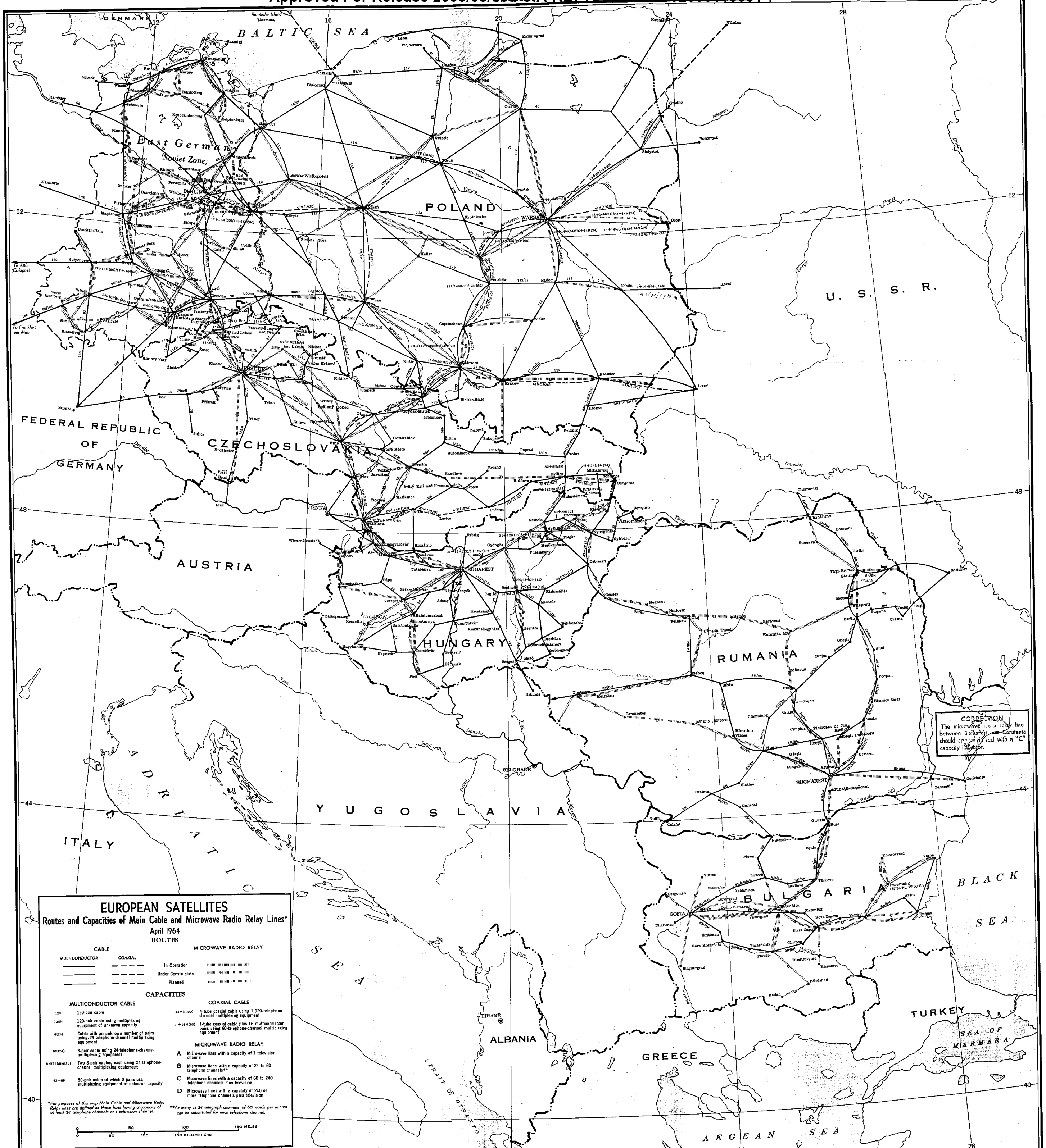
Figure 1



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the planned coaxial cable lines and 25 percent of the Vesna-type microwave radio relay lines are operational, a considerable part of the facilities under construction are nearing operational status. On most coaxial cable routes under construction in Poland and Czechoslovakia, for example, the cable and repeater tanks already are installed, with partial or full operation contingent on the installation of associated multiplex equipment. As for microwave radio relay lines, Vesna-type towers are completed or are nearing completion on nearly all routes under construction in Bulgaria, Hungary, and Rumania, and the installation of transmission equipment is believed to be imminent.

Apart from the choice of transmission systems, a determined effort to construct a diversified and reliable telecommunications system is explicit in the configuration of both the domestic and the intra-Bloc networks. The arterial routes of most domestic networks consist of parallel microwave radio relay and hardened cable systems. Duplication of high-capacity transmission systems also is provided for in the network of intra-Bloc lines. The main axis of this network interconnects Moscow, Warsaw, Prague, and East Berlin with parallel installations of 4-tube coaxial cable and Vesna-type microwave radio relay lines. This balanced installation of facilities, including the hardened construction of cable terminal and repeater stations and the construction of bypass cable rings around major industrial and strategic areas, improves the reliability of communications inasmuch as traffic can flow over alternate media or routes should any part of the network become inoperable. Photographs of microwave radio relay and coaxial cable facilities are shown in Figure 1A.*

2. Automation of Telephone and Telegraph Systems

The introduction of modern high-capacity transmission systems has given added stimulus to the efforts of the European Satellites to automate their domestic telephone and telegraph systems. Gains in converting these domestic systems to semiautomatic and fully automatic operations are emphasized by the progress made in establishing new automated networks for intra-Bloc telephone and telegraph traffic.

a. Telephone

The first stage in the construction of an automated long-distance intra-Bloc telephone network is nearing completion. The network, as shown on the map, Figure 2,* should be operational by the end of 1964, at which time it will connect each of the capital cities of the European Satellites and the USSR with one another and with the

* Following p. 6, below.

capitals of Western Europe. Initially the network will operate on a semiautomatic basis, with conversion to fully automated subscriber dialing scheduled by the end of 1974.

Warsaw, Prague, and East Berlin have dual roles in the network, functioning both as main terminals and as main transit centers. In this latter capacity they control and direct the flow of all network traffic. In 1961, experimental operations were successfully conducted on test lines between Moscow, Prague, and East Berlin and between these cities and a number of cities in Western Europe. In these tests a new crossbar exchange, the Tesla MN-60, was used. This exchange -- designed jointly by Soviet, Hungarian, East German, and Czechoslovak technicians -- is now in series production at the Tesla factories in Czechoslovakia and will be used throughout the network. Currently, MN-60 equipment is installed at the new international exchange offices located in East Berlin and Prague, and installation of similar exchanges is underway in Warsaw and Moscow. When the Warsaw and Moscow exchanges are completed late in 1964, network operations will begin. In the initial period, Budapest, Sofia, and Bucharest will be connected to the network through their existing exchange facilities. These exchanges also will be supplied eventually with MN-60 equipment.

b. Telegraph

A fully automated general telegraph (GENTEX) network for intra-Bloc telegraphic communications was activated in June 1962. The coverage of the GENTEX network, which is independent of the domestic telegraph and subscriber telegraph (TELEX) systems, is shown on the map, Figure 3.

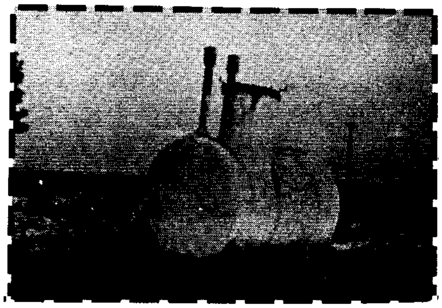
Since attaining operational status the GENTEX network has functioned smoothly. The automatic routing of telegraph traffic through intermediate points of the network has enabled the normal telegram transmission-delivery cycle to be reduced to about 30 minutes and has improved significantly the quality of service.

Consideration is being given to the expansion of the GENTEX network to include additional Bloc terminals and to the interconnection of the GENTEX network with similar networks now operating in Western Europe. Eventually, new Bloc terminals probably will include all main stations of individual domestic telegraph systems. Their inclusion, however, will be dependent on conversion to fully automated operations, a step that is currently underway in most of the European Satellites.

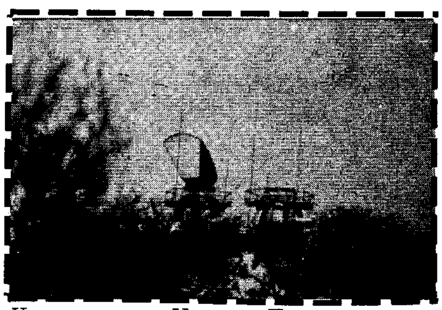
3. Intra-Bloc Television Network

In the entire spectrum of Bloc pronouncements in the field of telecommunications, the greatest publicity has been given to the

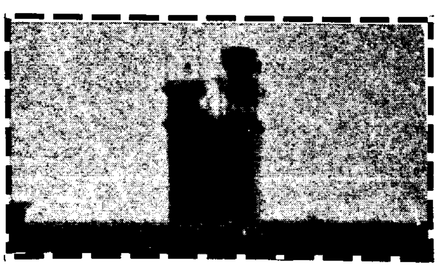
Poland: Buried Coaxial Cable Repeater at Rzeszow



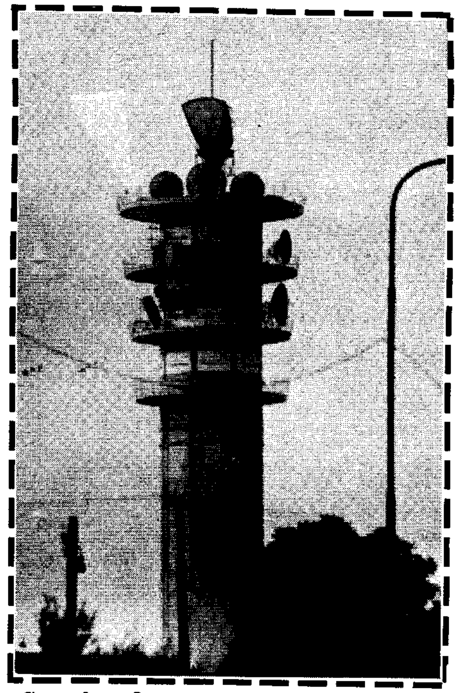
Poland: Coaxial Cable Repeater Awaiting Installation at Krakow



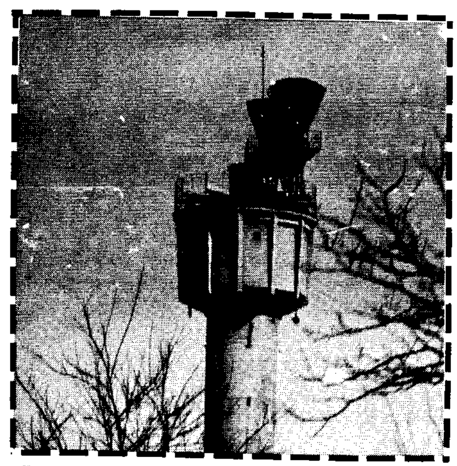
Hungary: Vesna-Type Microwave Radio Relay Facility at Budapest



Bulgaria: Vesna-Type Microwave Radio Relay Facility at Turnovo



Czechoslovakia: Vesna-Type Microwave Radio Relay Facility at Prague



Rumania: Vesna-Type Microwave Radio Relay Facility at Adunatii-Copaceni

Figure 1A. European Satellites: Coaxial Cable and Vesna-Type Microwave Radio Relay Facilities

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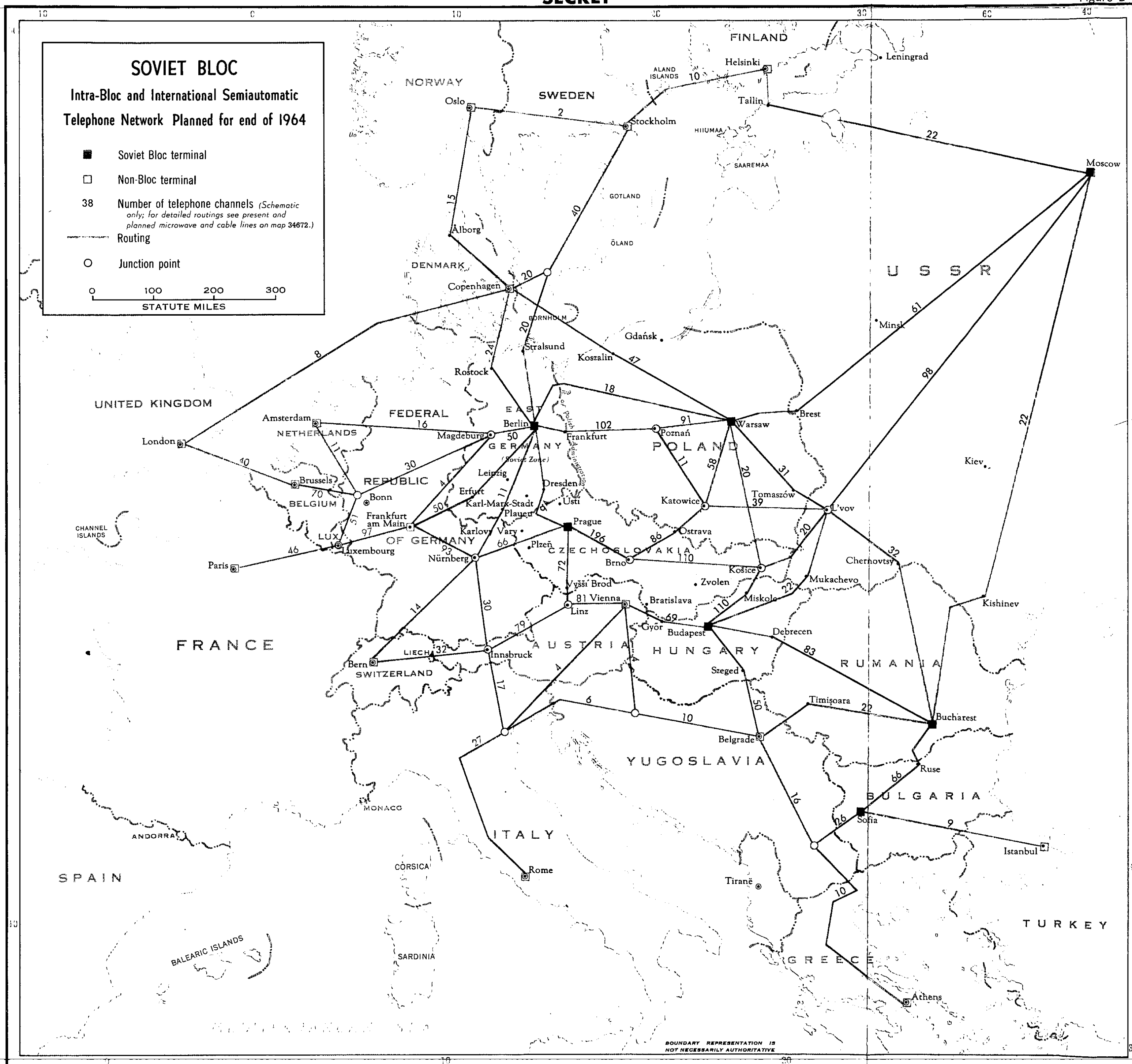
Figure 2



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GROUP 1
EXCLUDED FROM AUTOMATIC DOWNGRADING AND DECLASSIFICATION

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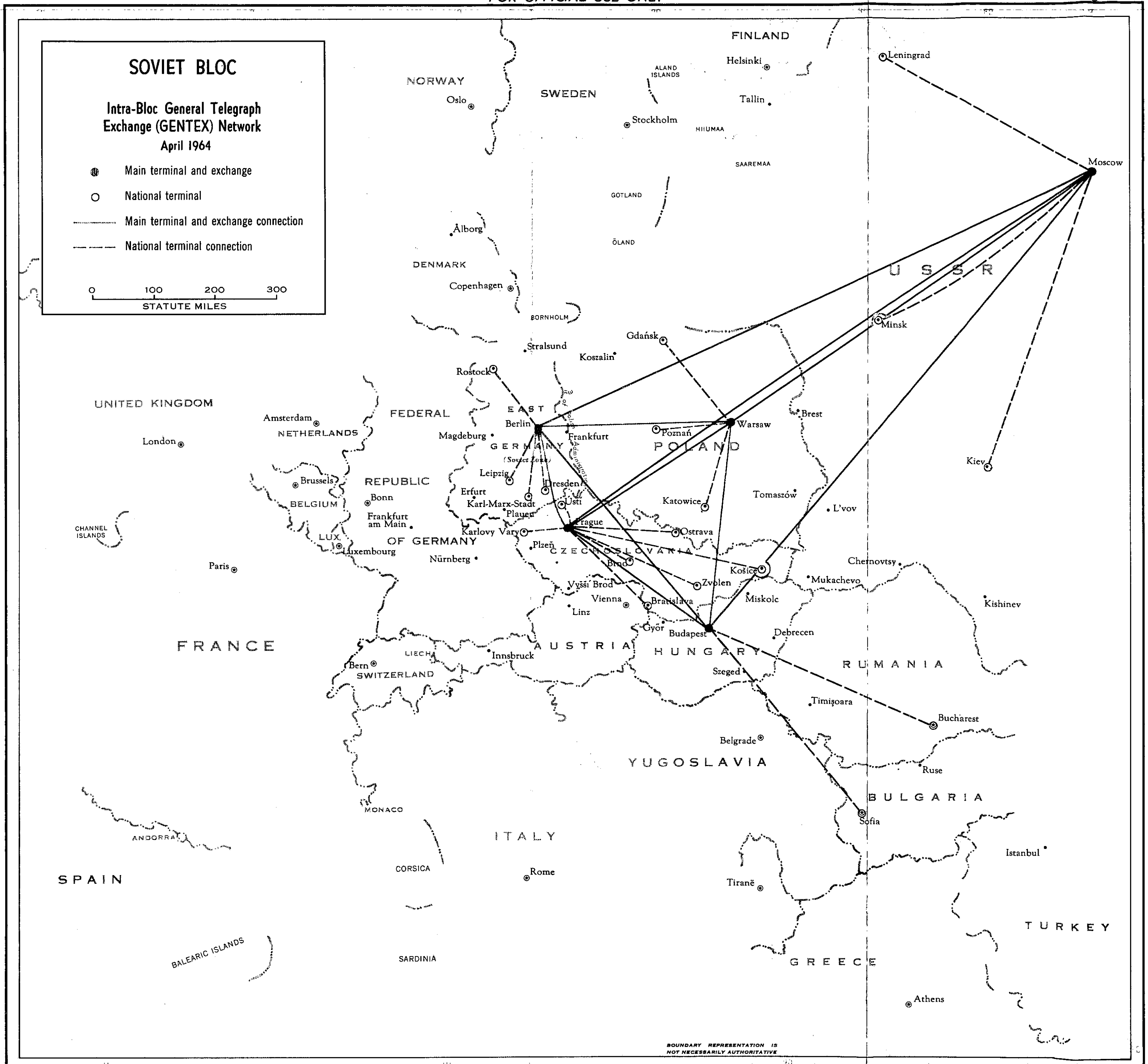
Figure 3



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establishment of the Bloc-wide television network Intervision. Sponsored by the International Radiobroadcasting and Television Organization (OIRT),* Intervision connects the television systems of the European Satellites and the USSR and provides connections with Eurovision, the Western European television network. Network operations began in 1960, at which time the television systems of East Germany, Czechoslovakia, Hungary, and Poland were linked through the use of temporary microwave radio relay facilities. Since that year, coverage of the network has grown steadily, and temporary connections subsequently have been replaced by fixed installations. In 1962 the USSR joined the network, and Bloc-wide coverage was achieved early in 1963 when the television systems of Bulgaria and Rumania were linked to the network.

The main network of arterial intra-Bloc and domestic communications lines serves as the transmission base for the Intervision network. These facilities (shown on the map, Figure 1**) depict main Intervision lines and border connecting points and provide some insight into the coverage of the television systems of individual Satellite countries. Because of the multipurpose nature of these new arterial lines, it is not unreasonable to assume that the publicity given to the establishment of the Intervision network, at least in its formative years, served as a convenient facade to shield the development of a strategic telecommunications resource base. In any case, the Bloc-wide functioning of the network demonstrates that still another major goal of OSS is nearing completion.

C. Major Problem Areas

As might be expected, problem areas exist that may prevent the European Satellites from meeting all plans by 1965. Foremost among these, and indeed the most pressing immediate problem, is the shortage of carrier-frequency multiplex equipment. Such shortages have existed since the inception of the program, and there is no evidence to suggest that significant progress has been made during the past 5 years toward the elimination of these shortages. The immediacy of the problem stems from the buildup of intra-Bloc and national arterial routes that has carried with it a massive requirement for associated multiplex equipment with capacities ranging from 12, 24, and 60 telephone channels up through and including equipment capable of handling 1,920 telephone channels. An adequate supply of such equipment is absolutely necessary for the full or even partial functioning of newly constructed lines as well as those scheduled for completion by the end of 1965.

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* OIRT is an agency organized and dominated by the Soviet Bloc that effects cooperation among Bloc countries as well as some non-Bloc countries in the field of radiobroadcasting and television.
** Following p. 4, above.

Although 12-channel and 24-channel equipment appears to be manufactured in sufficient quantities to meet new and recurring needs, series production of equipment with a capacity of 60 or more channels lags seriously. At present, East Germany, Hungary, and Czechoslovakia are the only European Satellites producing 60-channel equipment, and their output falls far short of minimal needs. Furthermore, production of higher capacity equipment is nonexistent even though research for the development of such equipment has been underway for a number of years. Because of these failings, lines completed during the last 3 or 4 years are not being equipped to operate at levels approaching designed capacities. The magnitude of this problem is indicated by the fact that no completed Vesna-type microwave radio relay line in the European Satellites is known to be passing telephone traffic. Similarly the passage of telephone traffic over the nearly completed 4-tube coaxial cable route connecting Poland, Czechoslovakia, and East Germany is wholly contingent on the ability of the USSR to supply associated carrier equipment. In spite of the fact that a commitment has been made in this regard, it is still not certain that it will be met as scheduled.

The lag in the availability of carrier equipment is related to continued difficulties in mastering techniques for the series production of uniformly high-quality components, such as crystal filters and metal contacts. Even when 60-channel equipment has been delivered and installed, its performance has often failed to meet minimum standards. An outstanding example of this is the V-60 and V-60S equipment produced by East Germany.

D. Emergence of a Bloc-Wide Strategic Telecommunications Complex

The end of 1965 will see the emergence of a Bloc-wide telecommunications complex that can promote more effectively the economic, military, and political interests of the area. Although the arterial routes of intra-Bloc and domestic communications lines in the European Satellites will not be completed fully by the end of 1965, they will nevertheless begin to function as an integrated network that is capable of handling a broad array of conventional and specialized service. This vastly improved level of communications will be achieved in spite of the difficulties that are being experienced in equipping the new transmission systems.

This improved capability will have a significant impact on the posture of military communications. The new complex of arterial transmission systems will contribute greatly toward closing the gap existing between the modern offensive and defensive weapons systems deployed throughout the European Satellites and the communications facilities and services needed for their support. The increased reliability of these facilities as well as their extensive geographic coverage (which includes all major areas of strategic military importance) assures their use as the primary media for domestic and intra-Bloc military traffic. Usage will encompass a wide field of strategic and tactical military applications ranging from supporting long-distance command-control structures to meeting national and Bloc air defense requirements. Gains made in automating domestic and intra-Bloc telephone and telegraph networks also will serve to enhance the strategic military significance of the emerging Bloc telecommunications system.

II. Plans and Prospects, 1966-75

In the early part of 1966-75 a push will be made to complete all main intra-Bloc and domestic communications lines and to equip these lines to their designed capacities. Some technological advances will be made by the introduction of new transmission media, but the main emphasis throughout the period will be on the expansion and automation of exchange and subscriber facilities, both domestic and intra-Bloc.

A. Technological Developments

1. Cable and Microwave Radio Relay Facilities

With the exception of the introduction of some 1.5 megacycle small-diameter coaxial cable and some more advanced microwave radio relay systems operating in the 6-gigacycle range,* there will be little over-all change in the basic composition of transmission systems. The use of small-diameter coaxial cable will be confined primarily to Poland and Czechoslovakia as feeder lines off main coaxial cable and microwave radio relay routes. For the most part, 6-gigacycle microwave radio relay equipment will be used to upgrade existing arterial microwave radio relay routes to meet additional traffic needs. This new microwave equipment, which is currently under development at the Budapest Telecommunications Research Institute, supposedly is capable of handling television traffic as well as 10,000 telephone channels. Reportedly it will use carrier equipment with a capacity of 1,920 telephone channels per radiofrequency trunk.

2. Scatter Facilities

There are no known operational tropospheric scatter facilities in the European Satellites. Moreover, there appears to be no operational requirement for this medium for mainline communications purposes even though East Germany is conducting feasibility studies over five experimental circuits. These circuits connect the main terminal at Kolberg (near East Berlin) with Dresden, Fichtelberg, and Inselberg (all in East Germany) and with Poznan (in Poland) and Prague (in Czechoslovakia).

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* One gigacycle equals 1,000 megacycles.

The applicability of tropospheric scatter to the communications requirements of the USSR is more apparent. Field tests of experimental tropospheric scatter systems in the USSR date back to 1957. At that time a circuit was set up between Leningrad and Petrozavodsk, a distance of 192 miles, using frequencies of 310 megacycles and 1,000 megacycles. The existence of a second experimental circuit between Frunze and Przheval'sk, a distance of about 180 miles, was announced in April 1958. More recently, official statements have alluded to plans for the construction of tropospheric scatter facilities by 1965. Evidence of operational systems, however, has been limited largely to isolated reports of probable tropospheric scatter antennas south of Moscow. In spite of this scarcity of information, it is believed that the USSR has a program for the employment of tropospheric scatter systems in the remote reaches of the Arctic and in Central and Eastern Siberia to support the growing economic and military requirements of these areas for high-capacity and reliable communications facilities.

3. Communications Satellites

Within the Soviet Bloc, only the USSR has the economic and technical resources to undertake an independent program for the establishment of a communications satellite system. There is, however, little incentive for the USSR to undertake such a program, as the major economic justification for a communications satellite is its use on high-density transoceanic routes. Although Soviet transoceanic communications requirements are growing through increased economic and political contact with non-Bloc countries, they are nevertheless minimal. Moreover, most of the high-density traffic requirements of the USSR are with contiguous European Satellite countries. Internal Soviet and intra-Bloc facilities that are planned for completion by the end of 1965 will have sufficient capacity and potential for expansion to satisfy these requirements at least through 1975.

The major alternative to establishing an independent communications satellite system is cooperating with the West in worldwide or regional systems. A joint venture with Western nations would be particularly attractive because it would enable the USSR to apply the scientific, engineering, and manufacturing resources necessary for an independent system to other priority programs and to relate service costs more realistically to service requirements.

Although Soviet intentions are unclear, there has been some recent evidence to suggest interest in cooperation with the West. If such cooperation materializes, access to Western communications satellite systems probably would be made available to European Satellite countries through Soviet ground terminals.

4. Electronic Switching Facilities

The European Satellites have tied long-run improvements in the quality and quantity of telephone service to the eventual widespread introduction of electronic telephone exchange (EATZ) equipment. The use of such equipment, which has no moving contacts, would increase switching speeds as much as 1,000 times and would reduce greatly the installation, operating, and maintenance costs. Since 1961, East Germany, under the aegis of OSS, has been coordinating a Bloc-wide effort to develop EATZ equipment for operational introduction by 1970 or soon thereafter. Efforts to date, however, have not resulted in significant progress because of problems in the mass production of low-cost, reliable semiconductor components with an operating lifespan of 20 to 30 years. Once this bottleneck is overcome, series production of equipment should move ahead. Significant quantities of such equipment, however, probably will not be available for operational use until 1975.

B. Completion of a Modern Telecommunications Resource Base

In their attempt to complete a modern telecommunications resource base by the end of 1975, the European Satellites will be faced with an expanding requirement for investment funds and equipment. The completion of new transmission systems soon after 1965 will not terminate the need for large capital outlays.* Rather, it will signify the end of one stage in the plan for the development of telecommunications and the beginning of another more intensified stage -- that of expanding telephone, telegraph, and data exchange and subscriber facilities so as to exploit the expanded channel capacities of new domestic and intra-Bloc networks. In countries such as Poland and Czechoslovakia, for example, plans for 1960-80 provide for the rapid expansion of all telecommunications services, including a major program for installing 5 million more telephones in each country. Given a minimum estimated investment cost of $200 for each additional telephone subscriber line, capital outlays in each country for telephone facilities alone would approximate $1 billion for the 20-year period. This level of investment, even when considered on an annual basis of $50 million, coupled with investments involved in enlarging other telecommunications services, will constitute a heavy demand on the financial and economic resources of these countries for telecommunications.

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These factors suggest that not all major objectives for modernizing and expanding the telecommunications system of the European Satellites will be met by the end of 1975. The strategic importance of intra-Bloc systems insures their completion, but it is unlikely that complementary goals for enlarging domestic systems will be met entirely. Even if the attainment of domestic goals is delayed as much as 5 years, however, the telecommunications systems of the European Satellites, in view of the extensiveness of the over-all program, will be improved vastly by 1975.